made by the two small arms, which gave muzzle velocities of 1437 f.s. and 1713 f.s. When proper arrangements were made, the photographs of the projectiles fired by these two guns were always very fine and sharp. With a sufficient velocity of the shot, the limit of the condensed air-wave in front of the projectile appeared to be of a hyperboloidal form, whose vertex was in advance of the projectile, and axis in the line of flight. Similar traces in the photograph, indicating conical waves whose axes were also in the line of flight, took their rise from the base of the shot. Other but weaker traces of waves of air took their rise from points on the surface of the shot. All these straight lines in the photograph were inclined to the line of flight at a rather less angle than the traces of the head wave. When the velocity of the projectile was increased, the angles which the traces of the waves made with the line of flight were diminished.

When the highest velocities were obtained, the channel vacated by the projectile was immediately filled with peculiar little clouds, which appeared almost as regular and symmetrical as beads strung on a line stretched in the direction of the line of flight. And there was no indication of a vacuum in the rear of the shot, even when the velocity was so high as 900 m.s. (2953 f.s.). As the air was transparent, the form of the waves of air in the photographs must have been caused by the varying density of the air, which refracted the rays of light.

Long ago Robins noticed a change in the law of resistance of the air to projectiles at about the velocity of sound. Although Hutton disputed this change in the law of resistance and others ignored it, recent experiments have completely confirmed Robins's discovery. It now appears that the disturbances caused by the projectile in the air travel faster than the shot for low velocities, so that the compression of the air in front of the projectile is not sufficient to cause traces of waves in the photographs.

The two guns which gave satisfactory results with muzzle velocities of 1437 f.s. and 1713 f.s., showed widely different curvatures at the vertex of the wave of condensation in advance of the projectile. It was therefore very desirable that the velocity of the shot should have been exactly determined at the moment each photograph was taken. This condition has unfortunately not been sufficiently attended to, for although an improvised ballistic pendulum was used in some cases, it was soon discarded.

Afterwards the experimenters made use of guns of larger calibre. Salcher carried out experiments at Pola with a gun of 9 cm. (3·5 inches) calibre, which gave a muzzle velocity of 448 m.s. (1470 f.s.). Other experiments were made at Meppen, by Mach, assisted by his son, with a gun of 4 cm. (1·6 inch) calibre, which gave a muzzle velocity of 670 m.s. (2198 f.s.). The head wave appeared as a stronger and broader hyperbolic curve in the photograph, which was rather more in advance of the head of the shot than in the case where small arms were used. But when the velocities of the shot were nearly the same in the two cases, the traces of the waves in the photographs made nearly the same angle with the line of flight. This perhaps might have been expected, as it has been found experimentally that the resistance of the air to projectiles varies as the square of their diameter.

Further experiments were afterwards carried out in the laboratory. In this case projectiles composed of various metals were used, as brass, aluminium, and lead, which were of various forms. Attempts were made to determine the velocities of the projectiles in two different ways, neither of which can be regarded as quite satisfactory. In one case it was assumed that the work done on the projectile by a given charge of powder would be constant. But this assumption would not be true for considerable variations in the weight of the projectile. In the other case, the velocity was calculated by using the inclination, $a$, of the trace of the rear wave in the photograph to the line of flight, on the supposition that the velocity of sound = velocity of the projectile × sin $a$.

Much labour and ingenuity have been expended in bringing these experiments to their present satisfactory state. The ground has been well prepared for sets of systematic experiments made with useful forms of projectiles fired with various muzzle velocities. The results given by spherical projectiles might prove useful to the theorist. Other experiments might be carried out with ogival, hemispherical, and flat-headed elongated projectiles. In all cases the readings of the barometer and thermometer should be recorded, and the velocity of the projectile should be measured. The ballistic pendulum would probably give the best results if the block was shielded from the action of the wave of condensed air which accompanies the projectile.

Further, E. Mach has attempted to compare the velocity of the report of a gun with that of the projectile. In one series of his experiments, when the terminal velocity of the projectile was higher than the normal velocity of sound, the time of flight of the projectile, and the time in which the report of the gun travelled over the same distance, agreed very closely. But in another series, where the terminal velocity of the projectile was below that of sound, it was found that the time of flight of the projectile was greater than that of the report of the gun over the same distance. It was therefore considered that the report of the gun travels at the same velocity as the projectile so long as the velocity of the projectile is greater than that of sound. But when the velocity of the projectile is reduced by the resistance of the air below the velocity of sound, then the report of the gun travels in advance of the projectile, moving with the normal velocity of sound. As experiments are frequently made with velocities of the projectile more than double that of sound, there seems to be no difficulty in the way of deciding whether the report of a gun travels at the same velocity as the projectile for high velocities. If so, as appears probable, there arises the question as to the velocity with which the report of the gun travels in various directions from the muzzle of the gun. If a stretched membrane could be made to interrupt a galvanic current for a moment on the passage of a sound-wave, it would not be difficult to determine the law of propagation of the report of a gun in all horizontal directions. For the projectile might be made to cut equidistant screens, and if lines of properly prepared membranes, at the same distance apart as the screens, were run in various directions, each line being provided with its own galvanic current and marker, the progress of the projectile and of the report of the gun in the chosen directions might be registered on the surface of a cylinder rotating with a known velocity. B.

## *NOTES.*

ON Friday last, Mr. Isaac Roberts, F.R.S., of Maghull, Liverpool, was presented with an address on the occasion of his removal from Liverpool to his new observatory near Tunbridge Wells. The presentation took place in the Council Chamber at the Town Hall before a large and representative assembly. The Mayor (Mr. Thomas Hughes), who presided, referred in eulogistic terms to the services rendered to astronomy by Mr. Roberts in his chosen field of celestial photography. Principal Rendall proposed the adoption of the address, in which reference was made to Mr. Roberts's long and honourable business career in Liverpool, and to the important discoveries made by him in stellar photography. The address was signed by the Mayor, Principal Rendall and the Professorial staff of University College, many members of the City Council and of learned and scientific Societies in Liverpool, and other prominent citizens. Mr. John Hartnup, of the Bidston Observatory, seconded the motion, and it was supported by Mr. A. G. White, the President of the Master Builders' Association. The Mayor then made the presentation. Mr. Roberts, in responding, drew attention to the fact that the city contained no monument or record of the labours of the two great Liverpool astronomers, Lassell and Jeremiah Horrocks, and expressed his willingness to join in any movement having that object in view. He also explained that his reasons for leaving Liverpool were because of the unsuitable nature of the atmosphere for taking observations.

It is expected that the Electrical Standards Committee will arrange for a discussion, at the Leeds meeting of the British Association, on the best values to adopt for the units of electrical measurement.

Mr. W. C. Macdonald, a merchant of Montreal, has just made a munificent contribution to McGill College. He has given 150,000 dollars to the Law Faculty for the endowment of the Dean's and another chair, and also 50,000 dollars for the endowment of a Chair of Experimental Physics, and has offered to erect buildings for the Faculty of Applied Science, to include class-rooms and laboratories. Altogether, the value of Mr. Macdonald's gift is about 400,000 dollars.

At a meeting of the Council of the South Wales University College on the 2nd inst., Mr. Archibald C. Elliott was elected to the Engineering Professorship just founded at Cardiff.

The death took place, on the 29th ult., of Mr. Alexander Parkes, of West Dulwich, and formerly of Birmingham, at the age of seventy-six years. Mr. Parkes was well known as the inventor of the substance parkesine or celluloid, and also of many important manufacturing and metallurgical processes.

The death, on the 2nd inst., is announced of Mr. John Page, chief engineer of the canals of the Canadian Dominion, and the projector and constructor of the enlarged St. Lawrence Canal system.

The German Emin Pasha Relief Committee has received a telegram announcing the arrival of Dr. Peters with his Expedition in Usugara.

At the invitation of Sir William MacGregor, Mr. C. Hedley, of the scientific staff of the Queensland Museum, has gone to New Guinea for the purpose of making a thorough scientific investigation of the invertebrate fauna of the east coast of that country.

Mr. James Bennett has (according to the *Colonies and India*) been commissioned by Lord Knutsford to proceed to Lagos, to make full inquiry into and report upon the mineral and vegetable resources of the colony with a view to their further development. Mr. Bennett is the inventor of a special process for extracting, by means of chemicals, pure rubber from the milk of the wild fig-tree, of which several species are to be found in Lagos and the neighbourhood, and it seems likely that considerable advantage will accrue to the colony from his visit. Mr. Bennett will devote particular attention to such products as rubber, gums, fibres, and minerals, in which it is thought that the present trade of the colony may be largely increased, or which are considered likely to become subjects of local manufacture.

Mr. Brown, the South Australian Government Geologist, has left Adelaide for the north, having been specially commissioned to carry out the geological survey of the Macdonnell Ranges, and to report on the Hale River gold-field. He will be joined on the journey by two members of the Board already selected, and some valuable work will, it is thought, be accomplished by the party before they return.

According to the Report of the Oxford University Extension scheme which has been issued, and which comes up to the commencement of July, "Since June 1889, 148 courses have been delivered in 109 centres by 25 lecturers. Examinations were held at the conclusion of 119 courses, and the examiners have awarded certificates of merit or distinction to 927 candidates. The courses were attended by 17,854 students, and the average period of study covered by each course was 10 weeks." In 1885-86 the number of courses delivered was 27 only, and the number of lecture centres 22. Amongst the chief signs of progress recorded are (1) a great extension of University teaching in small towns; (2) a marked increase in the number of working men attending the lectures; (3) the arrangement of a number of successful and well-attended courses during the early summer months; (4) the establishment of 36 Students' Associations at various centres; and (5) the federation in two new districts of the various lecture centres. The Students' Associations are very valuable, inasmuch as "they encourage the students to undertake regular reading throughout the year in preparation for, or in continuation of, the courses of lectures." The federation movement is also extremely helpful. It enables the difficulty sometimes experienced in procuring lecturers to be more easily surmounted, and it fosters and stimulates local interest in the study undertaken. The Committee regrets that a greater proportion of students do not present themselves for examination, but those who do go through the ordeal appear, on the whole, to come out very creditably. Scholarships are given to the writers of the best essays on a number of subjects connected with those studied during the course; and "amongst the successful essayists," we are told, "were two carpenters, two clerks, a fustian weaver, an artisan employed in a Government dockyard, and three elementary teachers." In an examination recently held, those who were awarded certificates included "a national schoolmistress, a young lawyer, a plumber, and a railway signalman." Again, we are informed that "a course of lectures on zoology recently given by an Oxford lecturer in Devonshire was attended by a student whose essays convinced the lecturer of her singular powers of accurate and original observation. She was encouraged by the lecturer to undertake a course of systematic study, and at his suggestion became a candidate in the examination for scholarships at Somerville Hall, where she was elected to the second scholarship."

At the third summer meeting of University Extension and other students, which is to be held at Oxford in August, Mr. E. B. Poulton, F.R.S., will lecture on the influence of courtship on colour, and Mr. Francis Gotch on the physiology of the nervous system; Prof. Patrick Geddes will deal with problems of evolution, organic and social; Prof. Green, F.R.S., will give a course on geology; and Mr. C. Carus-Wilson lectures on geological phenomena. The teaching of geography, by Mr. H. J. Mackinder; protective adaptations in plants, by Mr. J. B. Farmer; and some aspects of light, by Mr. V. Perronet Sells, are also subjects announced in the programme.

During the cruise of the *Garland* on the west coast of Scotland in June, for the purpose of examining oyster and mussel grounds, Mr. Anderson Smith records the following captures of more especial interest to naturalists. The large *Pennatula quadrangularis* was found to be commonly distributed in great abundance in several lochs. The rare *Isocardia cor* was taken in the trawl in Loch Sunart, alive. *Balanoglossus* was obtained from deep water off Dunvegan, Skye, and may be considered the first specimen recorded from Scotland. The rare fish *Cepola rubescens*, L., or Red Band-fish, was taken off Jura, and is an addition to the fauna of the outer waters, although one or more specimens have been recorded from the Clyde area. Among *Crustacea* many interesting species were found, and the individual supply was such as to lead to the presence at some time or other of a more plentiful fish supply than was met with during the cruise.

A TELEGRAM from Quilimane announces the departure of an Expedition to Zumbo, under the command of Captain Soares d'Andrea, overseer of the River Zambesi. Satisfactory news is said to have been received of Senhor Joaquin Almeida's Expedition to Gungunghama, which landed at Chaichai, 30 miles above the mouth of the River Limpopo, on its way to Gazaland. Good news has also been received from Captain Cerales, in Bilene.

THE latest information of the Russian Expedition to Tibet, under the command of Colonel Pevtsoff, is contained in the following letter from the mining engineer Bogdanovitch, published by the Russian newspaper the *Messenger of the Volga*:—"Having happily passed through the winter at Nia, the Expedition set out on April 24 to traverse the defile of Idjelik-Khanoum, and thus reach Tibet. Colonel Pevtsoff had sent half his camels, carrying 23 bales with his collections, to the banks of the Cherchen River, where they could recover their strength with the abundant pasture. These animals are intended to facilitate our return to Russia. Our baggage will be carried into Tibet on oxen hired for the purpose. We ourselves are riding thither on horseback, carrying with us the light portion of our effects. We left Nia with 30 horses. During the winter M. Roborovsky made an excursion to Cherchen, and I made one to the mountains of Karangon-Fag, south of Khoten. During my tour I met Grombchevsky, who came with me to Khoten in February, and thence returned for a short time to Nia. The health of all the members of the Expedition is perfect, and during the winter we have received all our letters and papers from St. Petersburg, thanks to the good offices of M. Petrovsky, our Consul at Kashgar. We shall send our collections to Russia through his agency." M. Grombchevsky has informed the military Governor of the Syr-Darya district that the time of his journey has been extended until January 15, 1891. His Expedition has already traversed 5000 versts. M. Grombchevsky will pass the summer in exploring Tibet between Polon-Lhasa and Rudok.

THE July number of the *Kew Bulletin* contains further information on the cultivation and preparation of the colouring substance known as annatto. The present instalment deals with the West African seed, which does not appear to possess the qualities of that from Jamaica. A new method of preserving grain from weevils is suggested, while there is a long correspondence on Colombian india-rubber. The letters contain an account of a tree which yields rubber, and which is known in commerce as "Colombia Virgen." It has the peculiarity of growing at high elevations, and therefore in a comparatively cool climate. Another section deals with the fibre industry of the Bahamas, and particulars are given of the establishment of the botanical station at Lagos, the first of its kind on the West Coast of Africa. A letter from the Curator, Mr. McNair, gives interesting information respecting some of the plants under experimental cultivation there.

AN appendix to the *Bulletin* contains a list of new garden plants, including not only those brought into cultivation for the first time during 1889, but the most noteworthy of those which had been re-introduced after being lost from cultivation. Other plants included in the lists have been in gardens for several years, but either were not described or their names had not been authenticated until recently. All hybrids, whether introduced or of garden origin, described for the first time in 1889, are included. The list contains a reference to the place where the plant is first described or figured, or where additional information is given; besides the natural order and country, a brief notice of the habit and most striking points of each plant is given.

THE Lucayan Indians, who inhabited the islands now called the Bahamas, were the first Indians seen by Columbus. In less than twenty years this interesting people, numbering, according to the estimate of the conquerors, 40,000 persons, was wholly exterminated. The hammock was found among the Lucayans, and both the word and the thing were adopted by the Spaniards, through whom they were passed on to other nations. Various skulls have been recovered from caves in the Bahamas, and have been made the subject of a valuable paper by Mr. W. K. Brooks. This paper was read some time ago before the National Academy of Sciences, America, and has now been reprinted as a separate memoir, with carefully executed illustrations. Columbus testifies that the Lucayans were "of good size, with large eyes and broader foreheads than he had ever seen in any other race of men"; and Mr. Brooks says this agrees perfectly with the results he has reached, the most conspicuous characteristics of the skulls he has examined being the great breadth noted by Columbus, and the massiveness and solidity of the head. "We may, therefore, unhesitatingly decide," says Mr. Brooks, "that they are the remains of the people who inhabited the islands at the time of their discovery, and that these people were a well-marked type of that North American Indian race which was at that time distributed over the Bahama Islands, Hayti, and the greater part of Cuba. As these islands are only a few miles from the peninsula of Florida, this race must at some time have inhabited at least the south-eastern extremity of the continent, and it is therefore extremely interesting to note that the North American crania which exhibit the closest resemblance to those from the Bahama Islands have been obtained from Florida."

THE *Times* gives some details of the new expedition to the North Pole, for which the Norwegian National Assembly voted 200,000 kroner on the 30th ult., and which will be under the charge of M. Nansen. Hitherto, with one possible exception, all attempts to reach the North Pole have been made in defiance of the obstacles of Nature. It has been an open campaign between the endurance of man and the icy barrier of the Arctis Seas, in which Nature has always been triumphant. On this occasion a systematic and well-organized attempt will be made to ascertain if Nature herself has not supplied a means of solving the difficulty, and if there is not, after all, a possibility of reaching the North Pole by utilizing certain natural facilities in these frozen seas of which all earlier explorers were ignorant. The circumstances on which these new hopes are founded may be thus summarized. The *Jeannette* Expedition of 1879-81 and the loss of that vessel seemed to sound the knell of all expeditions to reach the Pole by Behring Straits; but in the end the results of that effort are shown to have been more satisfactory and auspicious than any of the officers of the *Jeannette* could have hoped for when, with extreme difficulty, they succeeded in reaching Siberia across the ice from their wrecked vessel. In June 1884, exactly three years after the *Jeannette* sank, there were found near Julianshaab, in Greenland, several articles which had belonged to the *Jeannette* and been abandoned at the time of its wreck by the crew, and which had been carried to the coast of Greenland, from the opposite side of the Polar Sea, on a piece of ice. This fact at once aroused curiosity as to how it accomplished the journey across the Arctic Ocean, and as to what unknown current had borne the message from Behring Straits to Greenland. However these objects reached Julianshaab, they could not have come in an eastern direction, through Smith's Sound, for the only current which reaches Julianshaab is that from the eastern coast of Greenland *viâ* Cape Farewell and the north. Nor is there much probability that they were borne in a western direction from the place where the *Jeannette* sank, for all the currents round Nova Zembla, Franz-Josef Land, and Spitzbergen are known, and it seems impossible for the ice bearing the relics of the unfortunate *Jeannette* to have traversed the intervening distance in the space of three years, even if it were possible at all. There remains only the alternative that there is a comparatively short and direct route across the Arctic Ocean by way of the North Pole, and that Nature herself has supplied a means of communication, however uncertain, across it. Increased significance to the discovery of the *Jeannette* relics in 1884 was given by the identification in 1886 of bows found on the coast of Greenland with those by the Eskimo in the vicinity of Behring Straits, at Port Clarence, Norton Sound, and the mouth of the Yukon River. M. Nansen's Expedition will endeavour to realize these hopes of a direct route across the apex of the Arctic Ocean. A specially constructed boat of 170 tons will be built, and provisions and fuel taken for five years, although it is hoped that two will suffice. The Expedition will consist of 10 or 12 men, and M. Nansen proposes to leave Norway in February 1892.

THE *Meteorologische Zeitschrift* for June contains summaries, by Dr. T. Hann, of the results of the meteorological observations at the following international Polar stations :—(1) Sodankylä, in Lapland, where observations were made for two years ending August 1884. (2) Möller Bay, in Novaia Zemlia—September 1882 to August 1883. (3) Ṡagastyr, at the mouth of the Lena —September 1882 to June 1884. The observer at this station remarks that they were all more susceptible of cold in summer than in winter; in autumn this susceptibility ceased. In winter they could expose themselves experimentally for a few minutes to a temperature of about – 58° F., with scarcely any clothing, without any unpleasant feeling. The explanation is probably to be found in the complete stillness of the air at the time.

THE Harvard College has published, as vol. xxii. of its Annals, the very complete and valuable series of meteorological observations made at the summit of Pike's Peak, Colorado, between January 1874 and June 1888. This station is the highest in the world, being 14,134 feet above the sea-level. The observations, which have been prepared for publication under the superintendence of the Chief Signal Officer, contain the actual readings taken several times daily, and for a portion of the time even hourly readings, in addition to monthly means for various hours. General Greely draws attention to several interesting facts resulting from a cursory examination of the data. The maxima of both pressure and temperature occur in July, and the minima in January; the annual march of both elements is the same, and the two curves are almost coincident. The mean temperature for the above period was 19°·3; the maximum observed was 64°, and the minimum – 39°. The maximum daily range occurs in July and September (about 14°·3), and the minimum in December (11°·6) which is only about half of the range on the low plateau country to the eastward. The precipitation exhibits peculiarities in its distribution throughout the year; 35 per cent. of the whole amount falls in the summer, and 33 per cent. in spring, the maximum occurring in July and the minimum in February. The mean wind velocity decreases gradually from 26·6 miles per hour in January to 12·5 in July, and 12·3 in August, and it decreases from 2h.–4h. a.m. to 11h. a.m. and noon. The mean hourly velocity during any day rarely exceeds 50 miles; the highest velocity was 112 miles per hour on May 11, 1881, which General Greely states has been frequently exceeded at exposed points on the Atlantic and Pacific coasts. The prevalent direction is from south-west to north-west. Pike's Peak is frequently visited by electrical storms, but they only occur when the air is moist; many interesting details of these are given in the extracts from the observers' journals, at the end of the volume.

THE Chief Signal Officer of the U.S. Army has published a valuable "Supplement to the Monthly Weather Review" for the year 1889, which contains a general discussion of the weather of that year over the United States and Canada, by Captain Dunwoody, illustrated by seven charts prepared from data from about 1000 stations. The annual mean temperature was highest in the southern parts of California, Arizona, and Florida, where it rose above 75°, and it was lowest in Manitoba, where it fell below 35°. The highest maximum temperature was 117° at Yuma, Arizona, on July 3. The highest temperature ever recorded by the Signal Service observers was 119°, at Fort McDowell, Ariz., in 1887. The lowest temperature reported by a regular station of the Signal Service was – 43°, at St. Vincent, Minn., on February 23. The lowest minimum ever reported by a regular station of the Signal Service was – 63°, at Poplar River, Mont., in 1885. With regard to atmospheric pressure, Captain Dunwoody remarks that the effect of marked departures from the usual distribution of monthly mean pressure was noticeable on the paths of the storms. In August and December, for instance, when the pressure over the Southern States was more than 0·1 inch above the normal, no cyclone traversed the country east of the Mississippi and south of the Ohio Rivers. With regard to rainfall, at several of the stations in the Middle Atlantic States, the annual amount was the heaviest ever reported, and the greatest deficiencies occurred in Louisiana and Washington. Fogs occurred in the vicinity of the Banks of Newfoundland most frequently from April to October; in August, fog occurred on 22 days, and in January and December on only 5 and 4 days respectively. The charts show, in addition to the mean values for 1889, the departures of that year from the normal values.

THE occurrence of St. Elmo's fire at sea has been lately studied by Captain Haltermann, of Hamburg, who made examination of a number of ships' log-books for 1884 and 1885, reporting 156 cases, in 800 months of observation (*Met. Zeits.*). He finds a greater number of cases in north than in south latitudes. And of 63 cases observed in the North Atlantic (the stormiest sea in winter) 49 occurred in the months November to April, and only 14 in the other half of the year. Of the total (156) only 27 were unaccompanied by thunder and lightning, and only 6 by precipitates of some kind. Snow and hail showers, with strong wind, seemed specially favourable. Of 133 cases accompanied by rain, there were only 15 without also thunder and lightning; while of 32 with hail, 18 were without thunder and lightning; and of 14 with snow, 12 without thunder and lightning. As to wind, there were instances with all degrees of intensity. The wind was in most cases (beyond 35° lat.) from equatorial direction, and this, with the commonly observed decrease of pressure, indicates that the cases mostly occurred in the front part of depressions. In 46 cases the barometer rose, and in 8 it was unaffected. In most cases the thermometer fell. Between the equator and 10° N. lat. 12 cases were observed, and not one in the corresponding region to the south, where the trade wind generally prevails. In the region of the constantly blowing trade wind St. Elmo's fire is never met with. The western half of seas extending polewards from 30° lat. seems to afford the best conditions. On the whole, the occurrence of St. Elmo's fire may probably be ascribed to the same causes as give rise to thunder and lightning.

MR. J. LLOYD BOZWARD, of Worcester, writes to us that "during a rainstorm on Tuesday (July 1), black rain fell in a district lying between the parishes of Crewle and Broughton Hackett in this county. In road-ruts where rain-water had collected, a considerable film of black sediment remained the day after the storm. The day had been remarkable for a dense canopy of shifting masses of dark-coloured clouds of the nimbus formation. Great rainstorms had been prevalent in this and the adjoining counties. The temperature had been low, and the weather rather like that of November than of July."

MR. L. W. WIGLESWORTH, writing from Brunswick, says:—"I am indebted to a friend for the following observation. A squirrel, in leaping from a height of 33 feet to the ground, caused itself, by means of curving its tail strongly to one side just before alighting, to swerve in its course and so avoid some hard substance upon which it would otherwise have fallen. It landed safely upon a more suitable spot. If no one has done so already, I should like to call attention to the use of the squirrel's tail as a steering and balancing organ during the animal's passages through the air. For other uses see NATURE, vol. xx. p. 603."

THE fresh instalment of the Panama Canal Report deals with the various plans and specifications submitted to the Committee, which are divided into four categories: (1) a canal completely isolated, and making no use of the existing rivers and streams; (2) a canal making use of the existing waterways; (3) a canal with a ship railway over part of the course; (4) a canal with a tunnel through the high land of Culebra. The Report points out the various defects or omissions in the different schemes.

MESSRS. GEORGE BELL AND SONS will publish in a few days an octavo volume entitled "The Diseases of Crops and their Remedies," by Dr. A. B. Griffiths. The work is illustrated with 51 figures, and the chemical treatment of plant diseases is fully discussed.

MR. G. CLARIDGE DRUCE, 118 High Street, Oxford, is compiling a Flora of Berkshire, which will give all available information upon the plants of that county and their distribution through it and the adjoining counties. In order to make the work as complete as possible, the compiler would greatly value any notes on plant occurrences which may be sent to him.

THE schoolmaster, it would seem, is not abroad in Spain, at least as far as geography is concerned. A leading journal of Barcelona announces that England has ceded to Germany Heligoland which is situated on the African coast. This fact suggests to it a number of ingenious political considerations. At the end of the article it is mentioned that Heligoland does not belong to anybody, and is situated between the African territories of Nyanza, Victoria, and the Congo.

SOME very remarkable observations on the production of the ripe figs of *Ficus Roxburghii*, Wall., have recently been published by Dr. D. D. Cunningham, F.R.S., of the Indian Medical Service. The species is diœcious, the male receptacles or figs containing perfect male flowers with pollen, together with imperfect or atrophied female or "gall-flowers," which never produce seed; the female figs contain perfect female flowers only. Both kinds of fig are visited by the "fig-insect," usually a species of *Eupristis*, for the purpose of laying its eggs in the ovary. This is effected in the "gall-flowers" of the male figs; but in the female figs the efforts of the insect to deposit its eggs within the ovary are frustrated by the great thickness of the wall of the ovary. It is very rare to find more than a very few grains of pollen in the female figs; and, according to Dr. Cunningham, the embryo-sac in the female flowers retains, up to the period of the visits of the insect, the character of a uninucleate cell without oosphere, synergidæ, or antipodal vesicles. The full development of the embryo in the female flowers is brought about simply by hypertrophy of the tissues, the result of the stimulation caused by the unsuccessful attempts of the insect to pierce the wall of the ovary. If these observations are confirmed, we have here one of the most remarkable instances of parthenogenesis yet recorded in the vegetable kingdom.

A NEW crystalline carbohydrate, of the composition $C_{18}H_{32}O_{16}$, named by its discoverers *stachyose*, has been extracted by Drs. von Planta and Schulze from the bulbs of *Stachys tuberifera* (*Berichte*, 1890, No. 10, p. 1692). It crystallizes from 90 per cent. alcohol in well-defined hard brilliant crystals belonging to the triclinic system, and containing three molecules of water of crystallization, $C_{18}H_{32}O_{16} + 3H_2O$. When these crystals are powdered, and heated to 103°–104°, they lose their water, leaving a colourless powder consisting of the free carbohydrate $C_{18}H_{32}O_{16}$. The crystals and their aqueous solution possess a faint sweet sugar-like taste, and the solution in water, which is of neutral reaction, rotates the plane of polarization strongly to the right. The solution does not reduce Fehling's solution until after warming with a mineral acid, when reduction rapidly ensues. On heating with nitric acid, the carbohydrate furnishes 37·3 per cent. of mucic acid. When heated with resorcinol and concentrated hydrochloric acid, a deep red coloration is produced. One of the principal products of the inversion of stachyose is galactose, as shown by the following experiment. About 30 grams of stachyose were boiled with a litre of 2½ per cent. sulphuric acid for an hour in a flask furnished with a reflux condenser. After cooling, the sulphuric acid was precipitated by barium hydrate, the barium sulphate filtered off, and the filtrate evaporated to a syrup. On extracting the syrup with 95 per cent. alcohol, and allowing the extract to evaporate over oil of vitriol, crystals slowly separated, possessing, after recrystallization, the right-handed rotation of galactose ($\alpha_D = 80^\circ\cdot5$). From these properties stachyose is considered to belong to the group of carbohydrates termed by Prof. Tollens crystallizable polysaccharides. In this group are included raffinose or mellitose, gentianose, and lactosine Stachyose resembles the latter substance very closely, especially as regards the formation of galactose on inversion; but it is distinguished from lactosine by its much lower dextro-rotatory power. As regards the preparation of stachyose from the *Stachys tuberifera*, the bulbs were first crushed and the juice extracted as completely as possible by water. The extract was then successively treated with lead acetate and nitrate of mercury, the lead and mercury removed by a current of sulphuretted hydrogen gas, the filtered liquid neutralized with ammonia and evaporated to a thin syrup upon a water-bath. This syrup was then poured into alcohol, when a thick precipitate was formed, which gradually collected as a dark-coloured syrup in the lower portion of the flask. After removal of the alcohol the syrup was dissolved in water, treated with phospho-tungstic acid, and filtered, excess of phospho-tungstic acid being subsequently removed by baryta-water. A stream of carbon dioxide was then led through the liquid, which was again filtered, evaporated, and poured into absolute alcohol, when a perfectly white precipitate was obtained, consisting of almost pure stachyose. The crystals are best obtained by pouring a concentrated aqueous solution of the precipitated carbohydrate into such a quantity of absolute alcohol that a 91 per cent. solution of alcohol is obtained. Crystals of stachyose immediately commence to separate.

FOR the first time since the establishment of the Gardens of the Zoological Society there is now to be seen there one of the ancient breed of the English wild cattle, Earl Ferrers having presented to the Society a fine young bull, which he captured in Chartley Park, Staffordshire. From Garner's "Natural History of Staffordshire" it appears that the wild ox formerly roamed over Needwood Forest. In the thirteenth century William de Farrarus caused the park of Chartley to be separated from the forest, and the turf of this extensive enclosure still remains almost in its primitive state. Here a herd of wild cattle has been preserved down to the present day, and they retain their wild characteristics, like those at Chillingham.

THE additions to the Zoological Society's Gardens during the past week include a Water-buck (*Cobus ellipsiprymnus* ♂), a Serval (*Felis serval*), six Vulturine Guinea Fowls (*Numida* *vulturina*), three Mitred Guinea Fowls (*Numida mitrata*) from East Africa, presented by Mr. George S. Mackenzie; a Tawny Owl (*Syrnium aluco*), British, presented by Mr. G. Gurney; a Long-eared Owl (*Asio otus*), British, presented by Miss Muriel Hele; a Feathery-footed Owl (*Athene plumipes*), a Black and White Jackdaw (*Corvus daiirica*) from Newchang, South Mantchuria, presented by M. J. De La Touche; two Indian White-Eyes (*Zosterops palpebrosus*) from India, a Yellow-winged Sugar-Bird (*Cæreba cyanea* ♂) from Brazil, a Dufresne's Waxbill (*Estrelda dufresnii*) from South Africa, six Vulturine Guinea Fowls (*Numida vulturina*) from East Africa, deposited; a Plumbeous Fish-Eagle (*Polioaëtus plumbeus*) from North-west India, two Golden-headed Parrakeets (*Cyanorhamphus auriceps*) from New Zealand, a Green-winged Dove (*Chalcophaps indica* ♀) from India, purchased; two Emus (*Dromæus novæ-hollandiæ*), received in exchange; a Yak (*Poëphagus grunniens* ♂), a Viscacha (*Lagostomus trichodactylus*), born in the Gardens.

## *OUR ASTRONOMICAL COLUMN.*

### OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on July 10 = 17h. 15m. 5s.

| Name. | Mag. | Colour. | R.A. 1890. | Decl. 1890. |
|---|---|---|---|---|
| | | | h. m. s. | ° ′ |
| (1) G.C. 4355 ... ... | — | — | 17 55 41 | −23 2 |
| (2) α Herculis ... ... | 3·1-3·9 | Orange. | 17 9 38 | +14 31 |
| (3) β Draconis ... ... | 3 | Yellow. | 17 28 0 | +52 23 |
| (4) ζ Draconis ... ... | 3 | Bluish-white. | 17 8 30 | +65 51 |
| (5) 205 Schj. ... ... ... | 8 | Very red. | 17 38 29 | −18 37 |
| (6) R Scuti ... ... ... | Var. | Red. | 18 41 36 | − 5 50 |

*Remarks.*

(1) Unfortunately this interesting object only attains a low altitude in this country, but it is quite possible that there may be some nights on which spectroscopic observations may be made. It is the object known as the "Trifid Nebula," which is thus described in the General Catalogue:—"A very remarkable object; very bright; very large; trifid; double-star involved." For a further description observers may refer to Herschel's "Outlines." The spectrum was recorded as "continuous" by Captain Herschel in 1868, but in the same year it was observed by Prof. Winlock at Harvard College, and found to contain bright lines. This observer records: "Spectrum of the multiple star continuous, with many bright lines and some bands; one end of spectrum at λ 4280± . . . one bright line seen by C. S. Peirce at λ 4980±." I am not aware that any further observations of the spectrum have been made, but these observations should certainly be repeated with as large an aperture as possible. There can be little doubt that the line near λ 4980 is really the chief nebula line at λ 500. The appearance of bands is especially interesting, as indicating that only a relatively low temperature can be in question.

(2) The spectrum of α Herculis is probably well known to everyone who possesses a telescope and spectroscope. It is a very beautiful one of Group II., all the bands being very wide and dark, giving an appearance of alternating bright and dark bands. From the observations of Prof. Lockyer, Mr. Maunder, and myself, there can now be little doubt that we have here to deal with a mixed spectrum of bright carbon flutings and dark metallic ones. One bright band in the green is coincident with the chief carbon band, and has, moreover, the same appearance. The measures of the dark bands in the green and yellow by Vogel and Dunér show close coincidences with the flutings of manganese (λ 558 and 586) and lead (λ 546), and I have confirmed these by direct comparisons. The principal object in inserting the star in this column is to remind observers that this is a good opportunity for them to demonstrate for themselves that in stars of this type we are dealing with cometary conditions, as indicated by the carbon radiation.

(3 and 4) These stars have spectra of the solar type and of Group IV. respectively (Gothard).

(5) Dunér describes the spectrum of this star as one of Group VI., in three zones, of which the green is the brightest. He states that the spectrum is rather feebly developed, but it is not clear whether this is due to the faintness of the star, or that the bands are narrow as compared with other stars of the group. If the latter, the star may be one of the long-required connecting links between stars of this group and stars of the solar type.

(6) The spectrum of this variable does not appear to have been recorded, although its magnitude at maximum is about 5. The minimum is irregular, 6·0–8·5, and the period, according to Schmidt, is about 168 days. There will be a maximum about July 14.

A. FOWLER.

SECULAR INEQUALITIES IN THE MOON'S MOTION.—In the *Astronomical Journal* for June 20, Prof. J. N. Stockwell contributes the abstract of a discussion of the problem of the secular variation of the motion of the moon's perigee and node. The value found for the secular variation of the mean longitude of the moon's node does not differ very materially from that found by Laplace and subsequent investigators. But it is otherwise with the secular equation of the motion of the moon's perigee; and if the value Prof. Stockwell has obtained for the secular motion of the moon's perigee is nearly correct, the value found by Laplace and his immediate successors cannot be regarded even as a first approximation to the value of that motion.

If the mean longitude of the moon's perigee be denoted by $\omega$, and the number of centuries from a given epoch by $i$, the variation $\Delta\omega$ of the mean longitude of the perigee at any number of centuries from the epoch are quoted by Airy as follows:—

| | $\Delta\omega$ |
|---|---|
| Laplace ... ... ... ... ... | $-30''\cdot55i^2$ |
| Börg and Burckhardt ... ... ... | $-29\cdot98i^2$ |
| Damoiseau ... ... ... ... | $-39\cdot70i^2$ |
| Plana ... ... ... ... ... | $-40\cdot23i^2$ |
| Hansen ... ... ... ... ... | $-39\cdot18i^2$ |
| Hansen ... ... ... ... ... | $-36\cdot31i^2$. |

Notwithstanding this agreement of the results of other investigators, Prof. Stockwell has found, by direct calculation, that $\Delta\omega$ is very nearly expressed by the formula

$$\Delta\omega = +15''\cdot61i^2;$$

and since the motion of the perigee is direct, it follows that this motion is *accelerated* instead of being *retarded* from age to age, as has been hitherto supposed. The application of the result to the discussion of some ancient eclipses is reserved for a future communication.

ANNULAR ECLIPSE OF JUNE 17.—The current number of the *Comptes rendus* contains a letter from M. A. de la Baume Pluvinel to M. Janssen, respecting his observations at Canea Photographs of the annular and partial phases were obtained, and will be of service in determining the diameters of the sun and moon. M. Pluvinel also finds that there is no difference between photographs of the spectrum of the edge of the sun during the annular phase and the ordinary solar spectrum. It is interesting to note that during the eclipse the temperature fell from 33°·4 to 27°·4 C.

## *THE ETHNOLOGY OF THE GAMBIA REGION.*

THE Governor of the Gambia, in his last Report, devotes a long section to an account of the African tribes connected with that settlement, of which the following is a brief summary:—

*Mandingoes.*—The head-quarters of this extensive and powerful race lie in the mountainous district near the sources of the Niger and the Gambia, extending as far as Kong. From this region they overran the surrounding country westward to Bambouk, and still pushed on, until the banks of the Gambia, as far as the sea, more or less, fell under their sway. At the present moment the principal countries on the north bank of the river are occupied mostly by Mandingoes, and the dominant tribes in Combo, on the south bank, are also of the same race, though the heathen Jolas in the bordering Fogni country are able to hold their own against them. They practically control the trade of the lower river. Three-fourths of the ground-nuts hitherto cultivated have been grown by them; the export of bees'-wax seems to be also dependent upon the Mandingoes, who bring it down from the interior of the Jola country. They also bring cattle and hides into the market, and cultivate cotton largely, which their women spin and weave into the country cloths which play